VIJAYANAGARA SRIKRISHNADEVARAYA UNIVERSITY
BALLARI

Syllabus for M.Sc. Environmental Science

(CBCS Semester Scheme)

Effective from 2016-17 Onwards

Department of Environmental Science

VIJAYANAGARA SRIKRISHNADEVARAYA UNIVERSITY

Jnana Sagara Campus, Vinayaka Nagar, Contonment

BALLARI-583104

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSTY,BALLARI.

COURSE STRUCTURE AND SYLLABUS FOR M.Sc (ENVIRONMENTAL SCIENCE) CBCS PROGRAMME

FIRST SEMESTER

Sl. NO	Subject Code	Title of the Paper	Teaching Hours	Credits	Exam hours	Marks	
						IA	Theory/Lab
Hard Core Papers-Theory							
1.	ENV.HC-1.1	Earth and Environment	4	4	3	30	70
2.	ENV.HC-1.2	Environment and Ecosystem	4	4	3	30	70
3.	ENV.HC-1.3	Energy-Resources and Problem	4	4	3	30	70
Soft Core Papers-Theory (Choose any one)							
4.	ENV.SC-1.4	Natural Resources and Human Impacts	4	4	3	30	70
5.	ENV.SC-1.5	Environment for Development	4	4	3	30	70
Practicals							
6.	ENV.HCP-1.6	Earth, Environment and Energy Resources	2	2	4	--	50
7.	ENV.HCP-1.7	Environment and Ecosystem	2	2	4	--	50
		TOTAL		**20**		**120**	**380**

Total Marks for the First Semester 500

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COURSE STRUCTURE AND SYLLABUS FOR M.Sc (ENVIRONMENTAL SCIENCE) CBCS PROGRAMME

SECOND SEMESTER

Sl. NO	Subject Code	Title of the Paper	Teaching Hours	No. of Credits	Exam hours	Marks	
						IA	Theory/Lab
Hard Core Papers-Theory							
1.	ENV.HC-2.1	Environmental & Chemistry Instrumentation	4	4	3	30	70
2.	ENV.HC-2.2	Environmental Pollution	4	4	3	30	70
3.	ENV.HC-2.3	Biodiversity and conservation	4	4	3	30	70
Soft Core Papers-Theory (Choose any one)							
4.	ENV.SC-2.4	Solid Waste Management and Resource Recovery	4	4	3	30	70
5.	ENV.SC-2.5	Environmental Statistics and Computer Applications	4	4	3	30	70
Practicals							
6.	ENV.HCP -2.6	Environmental Chemistry and Environmental Pollution	4	2	4	--	50
7.	ENV.HCP-2.7	Environmental Statistics and Biodiversity	4	2	4	--	50
Open Elective Paper (For Students other than Environmental Science .Choose any one)							
1.	ENV.OE-2.1	Natural Resources & Environmental Laws	4	4	3	30	70
2.	ENV.OE-2.2	Environmental Education	4	4	3	30	70
		TOTAL		**24**		**150**	**450**

Total Marks for the Second Semester 600

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSTY,BALLARI.

COURSE STRUCTURE AND SYLLABUS FOR M.Sc (ENVIRONMENTAL SCIENCE) CBCS PROGRAMME

THIRD SEMESTER

Sl. NO	Subject Code	Title of the Paper	Teaching Hours	No. of Credits	Exam hours	Marks	
						IA	Theory/Lab
Hard Core Papers-Theory							
1.	ENV.HC-3.1	Ecotoxicology	4	4	3	30	70
2.	ENV.HC-3.2	Occupational Health Hazards	4	4	3	30	70
3.	ENV.HC-3.3	Global Environmental Changes and Natural Hazards	4	4	3	30	70
Soft Core Papers-Theory (Choose any one)							
4.	ENV.SC-3.4	Waste-Water Treatment & Management	4	4	3	30	70
5.	ENV.SC-3.5	Environmental Impacts Assessment & Auditing	4	4	3	30	70
Practicals							
6.	ENV.HCP -3.6	Ecotoxicology	4	2	4	--	50
7.	ENV.HCP-3.7	Occupational Health Hazards	4	2	4	--	50
Open Elective Paper (For Students other than Environmental Science .Choose any one)							
1.	ENV.OE-3.1	Biodiversity Conservation	4	4	3	30	70
2.	ENV.OE-3.2	Sustainable Development for Human Welfare	4	4	3	30	70
		TOTAL		**24**		**150**	**450**

Total Marks for the Third Semester 600

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSTY,BALLARI.

COURSE STRUCTURE AND SYLLABUS FOR M.Sc (ENVIRONMENTAL SCIENCE) CBCS PROGRAMME

FOURTH SEMESTER

Sl. NO	Subject Code	Title of the Paper	Teaching Hours	No. of Credits	Exam hours	Marks	
						IA	Theory/Lab
Hard Core Papers-Theory							
1.	ENV.HC-4.1	Environmental Engineering and Pollution Remediation Technology	4	4	3	30	70
2.	ENV.HC-4.2	Environmental Modeling, Remote Sensing & GIS Applications	4	4	3	30	70
3.	ENV.HC-4.3	Environmental Laws, policy & Legislation	4	4	3	30	70
4.	ENV.HC-4.4	PROJECT WORK	--	4	--	--	100
5.	ENV.HCP-4.5	Environmental Modeling, Remote Sensing & GIS Applications	4	2	4	--	50
6.	ENV.HCP-4.6	Environmental Impact Assessment & Environmental Management system	4	2	4	--	50
		TOTAL	4	**16**		**90**	**410**

Total Marks for the Fourth Semester 500

Structure:

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSTY,BELLARY.

COURSE STRUCUTURE AND SYLLABUS FOR M.Sc ENVIRONMENTAL SCIENCE

courses	SEMESTER I			SEMESTER II			SEMESTER III			SEMESTER IV			TOTAL		
	C	P	M	C	P	M	C	P	M	C	P	M	C	P	M
Hard Core Theory	12	3	300	12	3	300	12	3	300	12	3	300	**48**	**12**	**1200**
Soft Core	4	1	100	4	1	100	4	1	100	--	--	--	**12**	**03**	**300**
Practical's	4	2	100	4	2	100	4	2	100	4	2	100	**16**	**06**	**400**
Open Elective	**--**	**--**	**--**	4	1	100	4	1	100	--	--	--	**08**	**02**	**200**
Project	**--**	**--**	**--**							4	--	100	**04**	**--**	**100**
Total	**20**	**--**	**500**	**24**	**--**	**600**	**24**	**--**	**600**	**20**	**--**	**500**	**84**	**22**	**2200**

(Under CBCS)

ELIGIBILITY FOR M.Sc. IN ENVIRONMENTAL SCIENCE, ADMISSION, INTAKE, ATTENDANCE, THE SCHEME OF EXAMINATION, INTERNAL ASSESSMENT ARE AS PER THE UNIVERSITY RULES AND REGULATIONS.

SCHEME OF EXAMINATION

In each theory course, after completing 50% of the syllabus there shall be a written internal assessment test (CI) for 10 marks and a seminar for 5 marks. Similarly, after completing the remaining 50% of the syllabus there shall be one more written internal assessment test (C2) for 10 marks and a seminar for 5 marks. The total marks secured by the student in the internal examination in a course will be sum of the marks obtained in two written tests (C1+C2) and two seminars.

In each practical course, there shall be 10 marks are earmarked for Viva- Voce and 05 marks for practical record book.

In the final year the candidate has to go for a Tour/ Educational Field study and submit a report on the same.

The candidate has to work for a project work on a specific topic in the Final year of the course. He/she shall submit a Dissertation on the project work for evaluation at the end of the Final year.

Theory Question Paper format for Semester Examinations
The format for Hard Core, Soft Core and Open elective Theory Paper for 70 Marks & 3 Hours duration consists of

Question 1: Consists of 10 Sub Questions of 2 marks each covering all units (2X10=20 Marks)
Question 2: Consists of 4 Sub Questions with 5 marks each with choice, with total number of questions not exceeding 6 covering all units (5X4=20 Marks)
Question 3: Consists of 3 Sub Questions with 10 marks each with choice, with total number of questions not exceeding 5 covering all units (10X3=30 Marks

ENV.HC-1.1: Earth and Environment 52 hrs

Unit 1:*Introduction to Earth and Environment*: Solar System; the Earth as a planet orbiting the Sun; Earth's internal structure – the core, the mantle and the crust, Plate tectonics and continental drift, seafloor spreading and subduction; Relationship between Earth and environment; Influence of geologic process on changing environment. 10 hrs

Unit 2: *Early Environment of the Earth*: Prebiotic Earth, Physical and climate conditions of early Earth; Sources of water and organics of the Earth; Composition of early Atmosphere; Development of life 6 hrs

Unit 3: *Lithosphere*: Definition; Oceanic, and continental crust; and minerals; ***Rock and Minerals***- Classification of rocks, the rock cycle - weathering, erosion, transportation and deposition, Rock and minerals as resources. ***Soil*:** Formation, composition types and Profile. Physical and chemical properties of soil, Soil as a resource, Soil erosion-factors and consequences. 12 hrs

Unit 4: *Hydrosphere*: Definition; Distribution of Water on the Earth- Surface and sub surface water; Glaciers, Ocean and freshwater. The hydrologic cycle - precipitation, interception, infiltration, ground water, run-off and evaporation, the energy components of the cycle - solar radiation and gravitational force. 8 hrs

Unit 5: ***Atmosphere and Biosphere***: Definition; composition, stratification. Earth's climate- climatic zones of the world. Indian climatic zones. Definition; Origin and extent of the biosphere; Biome- major biomes of the world 8 hrs

Unit 6: ***Environment:*** Definition and development. Basic Structure and function of Environment; Ecosystem function-classification of environmental system- by function- isolated systems, closed systems and open systems; by degree of human disturbance- Natural, modified and controlled systems- Environmental limits. Environmental Crisis. 8 hrs

References:

1. Miller G. Tyler, Spoolman and E.Scott. 2010. Environmental Science. 13th Edition. Cengage Learning, Melbourne. Pp 545.
2. Peter H. Raven, David M. Hassenzahl, Mary Catherine Hager, Nancy Y. Gift, Linda R. Berg. 2015. Environment. 9th Edition. John Wiley and Sons, Inc. UK. Pp 528.
3. Valdiya , K.S, 1987 Environmental Geology

ENV.HC-1.2: Environment and Ecosystem 52 hrs

Unit 1: ***Energy in Ecological System***: Definition of ecosystem; abiotic and biotic components, Ecological relationships. Energy of life- sources of energy in the Earth ecosystem; the first and second law of thermodynamics, concept of productivity. flow of energy through ecosystem; food chain, food web and trophic levels; Producers, consumers and decomposers; Ecological pyramids. 10 hrs

Unit 2:*Ecosystem and Organisms*: Interaction of organisms- niche, competitive exclusion, limiting factors, co-evolution, symbiosis, mutualism, commensalism, Parasitism; Changes in communities over time- primary and secondary succession, pioneer community, climax community. 8 hrs

Unit 3: ***Ecosystem and the Physical Environment*:** The cycling of material within ecosystem, biogeochemical cycle; the carbon cycle, Nitrogen cycle and Phosphorus cycle; Physical environment- climate, solar energy, wind- atmospheric circulation; Oceanic currents- types, patterns and importance. 8 hrs

Unit 4: ***Biomes and major Ecosystems of the World***: Salient features and characteristics of biomes; major terrestrial biomes- Tundra, Taiga, temperate forest, grasslands. deserts, Savanna, tropical rain forests. Aquatic biomes and life zones; Freshwater ecosystems- lentic and lotic. estuaries, marine. 8 hrs

Unit 5*:* ***Population:***Concept of population, community, ecosystem, biosphere and ecosphere; Population density, abundance, indices; Population attributes- natality, mortality, emigration, immigration, distribution; Population growth forms and concept of carrying capacity; Population regulation, dispersal, energy flow; Allee's principle, Population interactions; Principles of limiting factors- Liebigs law of minimum, Shelford law of tolerance; Ecological indicators;Human population explosion and consequences. 12 hrs

Unit 6: ***Biotic Communities:*** Concept, intercommunity classification; concept of ecological dominance. Community analysis, Species diversity in communities, Patterns in communities, ecotone and edge effect. 6 hrs

References:

1. Peter H. Raven, David M. Hassenzahl, Mary Catherine Hager, Nancy Y. Gift, Linda R. Berg. 2015. Environment. 9th Edition. John Wiley and Sons, Inc. UK. Pp 528.
2. Eugene P. Odum: Fundamentals of Ecology. Published July 27th 2004 by Cengage Learning (first published January 1st 1961).
3. Kormandi… Fundmentals of ecology, John Wiley
4. Bevon, Mortimer and town send…… Indian Population of community.

ENV.HC-1.3: Energy-Resources and Problems 52 hrs

Unit 1: ***Energy***: Growing energy need and Energy crises; factors influencing energy crises; developmental strategies; energy supply and demand: energy consumption in developed and developing countries; Resources of Energy- Non-renewable fossil fuels, coal, natural gas, petroleum and renewable biomass, biogas, solar, nuclear, hydropower, wind and tidal and geothermal;Concept of clean energy. 6 hrs

Unit 2: ***Coal, Oil and Natural gas*****:** Coal- formation, forms peat, lignite, sub-bituminous coal, bituminous coal, steam coal, anthracite, chemistry and composition of coal Heat of combustion, thermal conductivity, specific and latent heat; major Coal reserves; advantages and disadvantages of coal energy, Fly ash and its environmental problems; Sub-terrainian coal fire; Oil and Natural gas : Geological exploration for oil and natural gas; Current status and reason for declining of reserve of oil and natural gas; Global oil demand and supply; Environmental problem associated with oil and natural gas; Synfuels and other potential fossil fuels resources. 10 hrs

Unit 3: ***Petroleum fuels***: Chemistry of petroleum fuels; empirical equations for thermal properties - Heat of combustion, thermal conductivity, specific and latent heat; Crude oil reservoirs and Unconventional oil reservoirs. uses of petroleum fuels; Environmental effects of use of petroleum fuels; ocean acidification, global warming, oil spills etc.; Alternative to petroleum fuel -for vehicles fuel, industries, and electricity. 8 hrs

Unit 4: ***Biomass and Biogas***: Definition, Biomass sources; World resources; Food crops, woody crops, natural vegetation, commercial planting, genetically modified varieties; biomass conversion- Thermal, chemical, biochemical and electro-chemical conversion; Environmental impact of biomass fuel. Biogas production and techniques; landfill gas. chemical composition of biogas; Benefits of biogas; global development of biogas; contribution of biomass and biogas to nature conservation. 8 hrs

Unit 5: ***Nuclear Energy*****:** Fission and fusion reactions; Atom and radioactivity; conventional nuclear fission; Production of electricity from nuclear power; Breeder nuclear fission; Merits and demerits of Nuclear power over hydal, thermal and coal based power plant; Problems associated with nuclear power plants; Safety in nuclear power plant; Radioactive wastes and environmental hazards. 8 hrs

Unit 6: ***Solar, wind, geothermal, hydrothermal and tidal energy*** **:** Solar energy- definition, harnessing using technologies -solar heating, photovoltaics, solar thermal

energy, solar architecture and artificial photosynthesis; Application of solar energy for solar- water heating, cooling, ventilation, cooking, water treatment etc.; Electricity production; photovoltanics, solar power panels; Solar energy equipment and ISO standard for solar energy equipments. Wind energy basics, equation for wind power. Wind farms. Small scale wind power productions. Environmental effects. Amalgamation of solar and wind power. Indian approach for solar and wind power. Energy generated hydro-power, geothermal and tidal; generating methods- types and capacities; advantages and disadvantages; Environmental impact. 12 hrs

References:

1. Richard S Stein and Joseph Powers, 2011. The Energy Problem. World Scientific Publishing Co. Pte. Ltd. Singapore. Pp 208
2. John Twidell and Tony Weir. 2006. Renewable Energy Resources. 2nd Edition. Taylor and Francis, New York. Pp 625.

Soft-core papers (Choose any one)

ENV.SC-1.4 Natural Resources and Human Impacts 52 hrs

Unit 1: ***Natural Resources*****:** Introduction, Ecological services of major ecosystems of the world; renewable and non-renewable resources- Continuous and extrinsic resources; natural resources and associated problems 6 hrs

Unit 2: ***Forest Resources:*** Composition, function, economic and environmental benefits- energy, medicine and life supporting substances; deforestation- causes of -timber extraction, dams, habitat fragmentation; anthropogenic influence on forest resources- over exploitation, encroachment, habitat quality depletion. grazing etc., 8 hrs

Unit 3:***Water Resources*****:** Hydrosphere; proportion of different types of water; Lentic and lotic water, ground water, use and over exploitation of surface and ground water; Problems associated with water resources- flood, drought and pollution-conflicts over water; current status of water resources in India; Problems and solution 10 hrs

Unit 4: ***Land and Mineral Resources*****:** Definition and degradation; landslide; soil erosion; overgrazing, mining, desertification, pollutions and their consequences on habitat quality; Economic minerals and exploitation; Metal and metallic compounds; rare earth metals, non-metals, building materials, gems etc., noble metals and fossil fuels; Mineral resources of India 8 hrs

Unit 5: ***Food Resources***: Introduction; types, characteristics; World food problem; agriculture and over grazing, modern agriculture- environmental effects. Agro-chemicals, soil salinity, Status of food resources and food contamination in India 8 hrs

Unit 6: ***Energy Resources and Natural Resources and conservation***: Growing energy demand, energy resources- renewable and non-renewable. Status of energy resources in India. Approach to fulfil the demand, new policy and schemes. Problems associated with overexploitation of natural resources, consequences on environmental quality and life supporting systems of the earth. Role of human communities and conservation, lifestyle, resource sharing and sustainable development. 12 hrs

References:

1. Andrew S. Goudie. 2013. The Human Impact on the Natural Environment: Past, Present and Future, 7th Edition. Wiley-Blackwell Publ. Pp 486.
2. John Walther, 2014. Earth's Natural Resources. 1st Edition. Jones and Bartlet Learning. Pp 428
3. Peteer Stilling (2004) Applied Ecology.

ENV.SC-1.5:Environment for Development 52 hrs

Unit 1: ***Our common future*****:** Link between development and Environment; evolution of Ideas and action – interrelationship among environment, economic and social issues; population and human resources; food security; species and ecosystem; energy; industry and urbanization. ` 6 hrs

Unit 2: ***Comprehensive plan of action:*** Agenda 21 - towards sustainable development-social and economic issues, poverty, human health and population; conservation and management of natural resources including the atmosphere, forests, biological diversity, wastes and toxic chemicals; the Role of nine major groups in implementing the sustainable development agenda local authorities, women, farmers, children and youth, indigenous peoples, workers and trade unions, NGOs, the scientific and technological community, and business and industry;means of implementation, including technology transfer, financing, science, education and public information. 12 hrs

Unit 3: ***Environment as a foundation for development*****:** Human beings as a centre of concerns forsustainable development and their relationship to a healthy and productive life in harmony with nature: Concept of good development- increasing the asset base and its productivity, empowering poor and marginalized communities; reducing and managing risks; long-term perspective for intra- and intergenerational equity. 8 hrs

Unit 4: ***Human Wellbeing*****:** Health- physical, mental and social wellbeing; material need considering ecosystem goods and services for adequate ecofriendly livelihood; environmental security; environmental change and human well-being. 8 hrs

Unit 5: ***Environmental changes- pressures and drivers*****:** demographic changes, economicdemand and trade, science and technology, institutional and socio-political frameworks -state of the environment with impacts on the environment itself, and on society and economic activity changes in emissions, land use and resource extraction. 8 hrs

Unit 6: ***Primary Drivers of Environmental changes and Degradation*****:** Massive population increase; rapid technological innovation; explosion in energy use and economic integration.Population increase, affluence, technology, poverty, market failure, policy/political failure, economic growth, nature of economic system; culture and values; forces of globalization. Consequences of degradation on environmental quality and sustainability. 10 hrs

References:

1. Bill Adams, 2009. Green Development: Environment and Sustainability in a Developing World. 3rd Edition. Routledge Publisher. Oxon. Pp356.
2. Diego Martino and Zinta Zommers. 2007. Environment for Development, UNEP.

Practicals

ENV.HCP-1.6: Earth, Environment and Energy Resources

Earth and Environment Practicals**:**

1. Identification of minerals
2. Identification of rocks'
3. Classification of soil'
4. Interpretation of land use/land cover from satellite images
5. Interpretation of flood and earthquake prone areas
6. Selection of dam sites
7. Interpretation of topo sheets
8. Study of water holding capacity of soil
9. Estimation of water balance.

Energy Resources :

1. Solar heaters and their uses.

2. Biomass (Wet and dry) estimation.
3. Estimation of calorie in plant and animal tissues.
4. Estimation of photosynthetic rate.
5. Estimation of rate of respiration

ENV.HCP-1.7 ***Environment and Ecosystem Practicals***

1. Sampling techniques for collection, preservation of phyto and zoo plankton
2. Qualitative study on diversity of phytoplankton and Zooplankton in water samples.
3. Quantification of microbes, phyto and zoo plankton
4. Application of Shannon-wiener and Simpson diversity indices
5. Ecological Sampling techniques-for vegetation and birds
6. Estimation of primary productivity

II Semester

ENV H.C. 2.1 Environmental Chemistry and Instrumentation

Unit 1: ***Atmospheric Chemistry:*** Introduction; Scope and Importance Chemical composition of air, Classification of elements, chemical speciation. Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermo-chemical and photochemical reactions in the atmosphere. CFC's and Ozone chemistry, chemistry of air pollutants, photochemical smog. 08 hrs

Unit 2: ***Soil Chemistry:*** Soil profile, distribution of inorganic and organic components in soil, Chemical properties of Soil - Saline, acidic and alkaline soils. Major micro and macro nutrients of soil, Nutrient Pathways - Nitrogen, phosphorus and potassium pathways in the soil. 8 hrs

Unit 3: ***Chemical pollution and fundamentals of chemical reactions:*** Acid-base reaction, oxidation, reduction, precipitation. Reactions of acids and bases reaction on surfaces-toxic chemicals in the environment biochemical aspects of As, Cd, Pb, Hg, CO, O3, PAN, pesticides, MIC and carcinogens in air. 8 hrs

Unit 4: ***Water chemistry:*** properties of water, water pollutants- types sources heavy metals metalloids-organic, biological and radioactive- types of reactions in various water bodies including marine environment. Chemistry of oil based and water based paints, physicochemical basis of redox processes. Electrochemical theory of corrosion. 8hrs

Unit 5: Basic chemical reactions: Redox Potencial, Oxidation and reduction, Ionic Potential. Acid basic reactions. Water and Organic solvents – Basic properties, Stochiometry. Photochemistry: Properties of light, Obsorption, kinetics of photo chemical Process, photo chemical smog. 8hrs

Unit 6:*Instrumentation and Analytical Techniques:* Theoretical principles of Analytical Techniques – Role and importance of analytical techniques in analysis of environmental samples. Titrimetry; types and applications of neutralization, precipitation, complexometric titrations; gravimetry, Conductometry, pH, Colorimetry, Spectrometry, UV-Vis and IR Spectrophotometer and AAS. Nephelometry, Flame Spectrometry and fluorimetry; Chromatographic techniques: Paper, Thin Layer, GC and Gas – Liquid Chromatography, HPLC, X-ray florescence, X-ray diffraction, Electrophoresis. 12 hrs

Reference Books:

1. De A.K (1989). Environmental Chemistry, II Ed., Wiley Eastern Limited.
2. Sawyer C.N, Mc Carty P.L and Perking G.F. (1994). Chemistry for Environmental Engineering, IIEd, Mc Graw- Hill.
3. Bailey, R.A. (1978). Chemistry of the Environment, Academic Press.
4. Vogel's Textbook of Quantitative Inorganic Analysis. (1978). IV Ed., Longman Group Ltd.
5. Jacobs. (1969). Analytical Chemistry of Industrial poisons. Hazards and solvents, M.B. Inter Science. New York.
6. Manahan S.E. (2000). Environmental Chemistry (7th Ed), Lewis Publications, Florida, U.S.A.

ENV.HC-2.2: Environmental Pollution 52hrs

Unit 1: ***Water Pollution and Water Quality Control:*** Introduction; COD and effective, sources of water pollutants, status of surface water quality; BOD; effect on water bodies; water quality index; Ground water pollution, control of contaminants in ground water; Contaminant transport, Waste water remediation technologies for surface and ground water; Effect of Water pollution on ecosystem and biota. Introduction, municipal and waste water systems in India; Water quality standards for drinking irrigation, industry, fishery and other ventures;Water treatment systems- manual water treatments Hazardous and Solid wastes, sewerage and sewage disposal technologies. 8hrs

Unit 2: ***Air Pollution:*** Introduction; overview of Emissions; Pollutant sources and their characteristics; Primary and secondary pollutants, toxic air pollutants; Air quality standards; Motor Vehicle emissions and stationary emissions- composition and control; Formation of aerosol and its effects; indoor air quality standards; air meteorology. models to predict smoke and pollutant dispersal in air- Box model, Gaussian Plume model; Effect of air pollution on biota 8hrs

Unit 3: ***Soil Pollution and Solid Waste:*** Introduction; Sources of soil pollutants- municipal, agriculture, aquaculture, poultry, industrial sources; Sources of Solid waste; Classification and characterization of solid waste; hazardous solid waste, Biomedical waste, Leachate of solid waste, etc.; transboundary movement of wastes;Physical, chemical, biological treatment of waste; disposal and recycling of solid waste; Effect of soil pollution on ecosystem and biota; **E- waste-** Introduction; sources, characterization, hazardous materials in e-waste, recycling of e-waste. 8hrs

Unit 4: ***Noise:*** Introduction, noise and vibration; sources of noise, noise and health; noise level measurement; permissible levels; Sonic boom; impulsive noise; anechoic chamber and reverberating sound: nosie topography; control of noise measure and regulations, effect of noise on biota. 8hrs

Unit 5: ***Thermal Pollution:*** Introduction; sources of thermal pollutants, effect of discharge of heat and effect of thermal pollution; measurement of thermal pollution, effect of thermal pollution on ecosystem and biota. 6hrs

Unit 6: ***Radiation Hazards and Radioactive Wastes:*** Introduction; effect of radiation on life, sources of radiation; radiation standards; nuclear energy and nuclear fuel cycle; effect of nuclear cycle on environment; monitoring of radiation; characterization of radioactive waste; storage and disposal of radioactive wastes; hazards of radio-active wastes. radio-active waste management programmes. 8hrs

Unit 7: ***Current Status of Environmental Pollutions in India****:* Prevention and control of generation, reuse and recycle of Waste; Acts and regulation to control pollution; National programme to control wastes. 6hrs

References:

1. Gilbert M. Masters and Wendall, P. Ela. 2014. Introduction to Environmental Engineering and Science. 3rd Edition. PHI learning Pvt. Ltd.Pp 708
2. Khopkar, S. M. 2004. Environmental Pollution- Monitoring and Control. New Age International Publishers, New Delhi. Pp484
3. William W Nazaroff and Lisa A Cohen. 2013. Environmental Engineering Science. Wiley Publishers Pp690

ENV HC 2.3: Biodiversity and Conservations 52 Hrs.

Unit-1: ***Biodiversity concept:*** Definition; components; types of diversity- Ecosystem diversity, Species diversity, and Genetic diversity; Plant, animal, microbial and human diversity; indigenous knowledge and biodiversity; values of biodiversity- consumptive use value, productive use value, social use value,ethical value,aesthetic value adoption values; ecosystem service values. 8 hrs

Unit 2: ***Global Biodiversity Assessment*****:** Introduction; scope; importance; assessment of diversity; diversity indices; point richness, Alpha, Beta, and Gamma diversity; endemism; key stone, umbrella and flag ship species, endemic species; their role in conservation; influences of ecotone, edge effect on diversity; loss of biodiversity-causes and consequences; species extinction. 6 hrs

Unit 3: ***Biodiversity Status*****:** Introduction, scope; criteria for assessment of international /national status; IUCN red list criteria; extinct, near to extinct, vulnerable, endangered and threatened biodiversity hotspots; criteria for hotspots; current status of biodiversity hotspots; India as mega biodiversity hotspot; threats to biodiversity in India; endangered and endemic species of India. 8 hrs

Unit 4: ***Biodiversity Provisions***: Introduction; collective rights, food security, right to land, territories and natural resources; equity; local knowledge; Knowledge-Attitude and Practice (KAP); cultural diversity, woman leadership role stop patenting life; People Biodiversity Register (PBR). 6 hrs

Unit 5: ***Biodiversity Conservation and Management*****:** Importance and need of biodiversity conservation; Conservation Assessment Management Plan (CAMP); strategies for Biodiversity conversation -*In-situ:* National park, Sanctuaries, Biosphere reserves, National parks, Bioparks, Ex-situ conservation- Botanical gardens, zoos, aquaria herbarium; In vitro conservation-germplasm and gene bank, tissue culture, pollen and spore banks, DNA banks; Man and Biosphere programme (MAB). 8 hrs

Unit 6:*New Conservation Strategies***:** Community reserves; community-oriented approaches; drawing from local values; knowledge and experiences; rendering civil society more responsive; harnessing voluntary action. 6 hrs

Unit 7:*Convention on Biological Diversity (CBD) and Biodiversity Act***:** Introduction;objectives of CBD; principle; measures for conservation and sustainable use-relevant articles (1 to 42) on CBD; sharing benefit; biological resources and biotechnology;conservation of eco-system: sustainable use of biodiversity; transfer of technology; adaption of biodiversity protocols;bio prospecting; Intellectual properties

right (IPR) .***Biodiversity Act:*** Provisions under biodiversity Act; National and International programme on biodiversity; species management. Important Acts (India) related to Biodiversity; Wildlife protection Act 1972; Forest Conservation Act 1980; Environment Protection Act 1986; Biological Diversity Act 2002; Biological diversity Rules 2004; Scheduled Tribe and other traditional forest dwellers (Recognition of Forest right) act 2006; International and National policies, Role of WWF, WCU, CITES, TRAFFIC. Role of Government and NGOs. State and National Biodiversity board. Environmental Education. 10 hrs

References:

1. Haywood, V. H. and Watson R.T. 1995. Global Biodiversity Assessment. UNEP, Cambridge University Press. PP 1140.
2. Gabriel Melchias. 2001.Biodiversity and Conservation. Oxford and IBH Publishing Co. Pvt. Ltd. Pp 236.
3. Michael J. Jeffries, 2005.Biodiversity and Conservation. 2nd Edition, Routledge London. Pp 232
4. Michael P. Marchetti; Peter B. Moyle, 2010. Protecting Life on Earth: An Introduction to the Science of Conservation. University of California press.
5. Krishnamurthy, K. V. 2003. Textbook of Biodiversity. Science Publishers, Inc. Plymouth. Pp 258.

Soft Core (Choose any one)

ENV SC 2.4: Solid Waste Management and Resource Recovery 52 Hrs

Unit 1:*Solid Waste Management*: Introduction; principles and objectives of solid waste management; level of planning - state, district, municipal and regional; waste generation pattern; recovery of resource and energy from waste; litter, hazardous and toxic wastes management plans. Methods of determining the quality and composition of wastes. 8 hrs

Unit 2: ***Strategy for Management and recovery plan***: introduction; short and long range; elements of plan for agriculture, biomedical, municipal, industrial and miscellaneous wastes dead animal, sludges, used tyres, waste oils, those generated at obscure level.6 hrs

Unit 3: ***Municipal, industrial and agriculture solid waste***: characteristics; storage and collection; transfer and transport; separation and processing –recycling of material and energy; biological treatment of solid waste including composting; thermal treatment of solid waste including incineration and energy recovery - Sanitary landfills including landfill leachate and landfill gas management. 8 hrs

Unit 4: ***Hazardous wastes*****:** characterization-toxicity, reactivity, ignitability, corrosively and infectivity; hazardous waste generators; transportation of hazardous waste; treatment; physical and chemical treatments-Neutralization, precipitation, oxidation and reduction, activated carbon absorption, solidification, encapsulation, distillation; biological treatments; disposal of hazardous waste; minimization of hazardous waste. 8 hrs

Unit 5: ***Design and operation of***waste source reduction; transportation systems; general waste treatment and energy and material recovery systems; incinerators; sanitary landfills, thermal treatment plants; hazardous waste treatment systems. Organic and inorganic wastes and designs associated with transport, treatment and recovery. 8 hrs

Unit 6:***Waste and climate change*****:** introduction; strategies for climate change mitigation; integrated solid waste management planning, with special emphasis on increasing carbon holding capacity, reduction in CO_2 and methane production; policies and regulations - Moving towards a resource-efficient zero waste society and 3Rs. 8 hrs

Unit 7: ***Cost and management of waste facilities and systems*****:** Introduction; capital and operating cost of the facilities; life cycle cost analysis; benefit from resource recovery; public participation in waste management and recovery of resource and energy. 6 hrs

References:

1. Charles R. Rhyner,Leander J. Schwartz, 1995. Waste Management and Resource Recovery. 1st Edition, Lewis Publisher, Washington. Pp 544.

2. Lens, P, B. Hamelers, H. Hoitink, W. Bidlingmaier, 2004. Resource Recovery and Reuse in Organic Solid Waste Management. IWA Publishing, NY. Pp 536.

3. United Nations Environment Programme. 2005. Solid Waste Management. Pp72.

ENV.SC 2.5: Environmental statistics and Computer Application

Part-A Environmental statistics 52 hrs

Unit 1: ***Introduction to Statistics:*** Introduction, scope, limitations of statistics and statistical method V/s Experimental method. Collection of data, sampling, classification and tabulation of data. Diagrammatic and graphic presentation of data. 8hrs

Unit 2: ***Descriptive Statistics:*** Introduction, measure of central location, mean, mode, median, measure of shapes. Properties of mean, measure of spread, variance and standard deviation, co-efficient of variation. 8hrs

Unit 3: ***Sampling theories and Hypothesis testing:*** Sampling theories, techniques and experimental designs. Testing hypothesis: Significance level and X^2 test, t and F test Correlation, regression and ANOVA: Analysis of variance: One way and two way ANOVA, MANOVA. Regressions: Defining the fit, Correlation, polynomial regression, multiple regressions. 8hrs

Part-B Computer Application

Unit 4: Introduction: History of computer; character and organization –types and generation of computer 6hrs

Unit 5: Hard ware and software: Types of memory; primary RAM, ROM, PROM, EPROM, EEPROM and secondary Floppy, hard disc, c band, DVD, video terminals, OMR, OCR, Printers and scanners. Operating system-Introduction; DOS; UNIX, Linex, MS-Office 8hrs

Unit 6: Information technology: Information; types; quality, needs, data processing, computer network and Internet. Computer application in Environmental Studies 8 hrs

Unit 7: Statistical Packages for environmental data: SPSs, MVSP, SAS mini tab, Graph Pad 6hrs

References:

1. Snedecor, W and G. Cochran, 1967. Statistical Methods. Oxford and IBH Publishing Co. Calcutta
2. Rosner, B. 1986. Fundamentals of Biostatistics. Duxbury Press, Boston
3. Ford, E.D. 2000. Scientific methods for Ecological Research. Cambridge University Press, Cambridge.
4. Zar, J. H. 1974. Biostatistical Analysis. Prentice-Hall, Inc Englewood Cliffs, New Jersey.

ENV.HCP 2.6: Environmental Chemistry and Environmental pollution

Environmental Chemistry

1. Sampling techniques of water and air.
2. Determination of pH, Electrical Conductivity and Turbidity of water sample.
3. Determination of Total Dissolved Solids in water samples.
4. Determination of Total hardness, calcium hardness and magnesium hardness by EDTA complex metric method.
5. Determination of Chloride in water sample by AgNO3 method.
6. Estimation of Phosphates in water by Ammonium Molybdate method.
7. Estimation of Sulphates in water sample.
8. Estimation of nitrates in water sample.
9. Estimation of fluorides in water sample.
10. Estimation of particulate matter, sulphur dioxide and oxides of nitrogen in ambient air.

Environmental pollution

1. Determination of pH and EC in water Samples.
2. Estimation of DO, Biochemical Oxygen Demand in water sample.
3. Estimation of Chemical Oxygen Demand in water sample.
4. Estimation of particulate matter in air using RDS/HVS.

5. Determination of SO2 and NOx in ambient air using RDS/HVS.
6. Modeling of air quality and air quality indices.
7. Determination of Air Pollution Tolerance Index.
8. Air and noise pollution Survey – questionnaire method.
9. Determination of instantaneous noise levels and continuous noise monitoring selected areas using sound level meter and data logger.
10. Computation of water quality index.

ENV.HCP 2.7: Environmental statistics and Bio diversity

Environmental statistics

1. Tabulation of data
2. Graphical presentation of data; line graph, bar chart, cumulative bar chart, percentage bar chart, pie chart and three dimensional graphs
3. Frequency analysis; Univariate and bivariate frequency tables
4. Calculation of correlation and regression, Data sheet and data management, Simple statistical work using Excel spread sheet, Power point files
5. Calculation of mean, median and mode.
6. Calculation of modal frequency; grouping table and analysis table
7. Testing the hypothesis; application of 't' test
8. ANOVA: application and problems

. **Biodiversity Practicals**

1. Study of shola Forest-diversity and climatic uniqueness.
2. Microclimatic studies and enumeration of biota of Shola forest.
3. Species diversity indices: Simpson, Shannon-Wiener indices.
4. Estimation of density and biomass of grasses
5. People Biodiversity Register-Demonstration and Assignment

Open Elective Papers (for students of other Departments)

ENV O.E 2.6 : NATURAL RESOURCES AND ENVIRONMENTAL LAWS 52 hrs

Unit 1: ***Natural Resources:*** Definition, Classification, concepts and distribution of natural resource in India and global level. Importance and applications of natural resources, Conservation and Management- Definition, Broad Classification, Renewable, Non Renewable and Mineral Resources. Renewable (Non Conventional Source of Energy). Solar Energy, Wind Energy, Geothermal Energy, Tidal Energy, Biomass energy (Bio Gas), Ocean Energy and Magnetohydrodynamic Power (MHD), Impact on Environment and their applications, Energy Production Consumption and Energy use pertain in different part of the world. Non Renewable (Conventional Source of energy): Thermal Power, Hydro Energy,

Atomic Energy, Nuclear Energy (Fission and Fusion) and Fossil fuels (Coal, Petroleum Oil and natural Gas). 12 hrs

Unit 2: ***Power generation from waste:*** Biogas plants - principles of generation, designs, application of biomass technology to increase the hydrocarbon chain. Pyrolysis. Biogas from solid waste. Biofuels. Conservation of Energy - Importance, Methods of Conservation, Barriers to Energy Conservation, Measures for Promoting Energy Conservation, Eco-Friendly Energy Sources, Energy Audit. 10 hrs

Unit 3: ***Mineral Resource management:*** Resources and reserves. Metals and Non-Metals, Formation of Mineral Deposits, Consequences of over Exploitation and Conservation of Mineral resources of India and their Distribution. Oceans as new areas for exploration of mineral resources. oceans ore and recycling of resources. 08 hrs

Unit 4: ***Water Resources Management*** - Concept and classification, integrated water resource management; Participatory watershed development; rain water harvesting. National Lake and River Conservation Programmes. Wetland management. Coastal zone management- concept, scope, issues and strategies. Implications of National River linking programme on environment. Water Conservation Strategies in India–Rain Water Harvesting. 10 hrs

Unit 5: ***Land and Forest Resources:*** Agricultural Practices in India - Exploitation of Agricultural Land. Range Land Management – Wasteland development – concept scope, issues and strategies. Forest resource Management: Importance of Forestry, forest products, Forest based medicinal & Pharmaceutical Industries. Forest management practices and programmes. Forest – land-use changes in India - future demand of forestlands. Afforestation and Joint Forest Management – Social Forestry, Agro-Forestry, urban forestry.34 Protected forest area management – Eco-development committees and Ecotourism. Gene pool management. Forest Fire and its Control. Wildlife habitat management- In-situ and Ex-situ conservation of Biodiversity in India. Conservation of key wildlife species – project tiger, project elephant, crocodile project. Role of Non Governmental Organizations in wildlife and forest conservation. Salient Features of Forest Act. 12 hrs

Reference Books:

1. V. P. Agrawal. (1968). Forests in India: Oxford & IBH Publishing Co. Pvt.Ltd. New Delhi.
2. Sitram Rao. Introduction to Social Forestry, Oxford and IBH Pub. Co. Pvt. Ltd.
3. Anand S. Bal. (2005). An Introduction to Environmental Management, Himalaya Publishing House.
4. Prabhakar V.K. Energy Resources and Environment, Anmol Publisher
5. Oliver S. Owen. (1980). Natural resources conservation – An Ecological approach, 3rd edition, Macmillan publishing Co. Inc. New York.
6. Agarwal and Rana S.V.S. (1985). Environment & Natural resources, society of Biosciences.
7. Nalini K.S. (1993). Environmental resources and management. Anmol publishers.
8. Aradhana P.S. (1991). Environ mental management. Rajat publishers.
9. Rajagopalan R. (2005). Environmental Studies, Oxford University Press, New Delhi.

ENV. O.E. 2.7 Environmental Education **52 hrs**

Unit 1. ***Introduction to Environmental Education:*** definition; importance of environment; Significance and concept, natural resources, renewable and non-renewable resources. Role of individuals in conservation of natural resources. People in Environment, Need for Public Awareness, Institution in Environment, Fundamentals of integration of knowledge, application to human society, Environmental Values, Environmental Pollution, Source of Pollution, Effects and abetment of Pollution, green house effect and global warning. ecology and Biodiversity. Community participation for ecological restoration and conservation, general perspectives; Role of NGO in environmental awareness. 13 hrs

Unit 2. ***Equity Environment versus Development:*** Equitable use of resources for sustainable life styles. Importance of critical review of plan with respect to local, regional and immediate and long term gains and Effect of Development. Comparison between - Exploitation and safe guard for conservation, Rate of utilization and regeneration, Natural and manmade growth, Survival need of mankind and protection of environment Integration of development with carrying capacity of Environment 13 hrs

Unit 3. ***Definition and concepts of sustainable development:*** Integration of Economic, Social and Environmental sustainability, Biodiversity and Availability of natural resources in development. Critical review of drawbacks in traditional evaluation of development and cost benefit analysis. Introduction of ecological growth factor similar to economical growth factor for sustainable development. 13 hrs

Unit 4. ***International Environmental Laws:*** Evolution and development of International Environmental laws with reference to Stockholm Conference, Nairobi Declaration, Rio Conference, Rio+5 and the Rio+10, etc. Global environmental issues and International laws: to control Global warming, Ozone depletion, Acid rains, hazardous waste, CITES etc. Role of UN authorities in protection of Global Environment, Multinational authorities and agreements, future of International laws. 13 hrs

References:

1. Environmental Education and Management -Dr.Avinash Chiranjeev
2. Environmental Education - Babita Verma
3. Environmental Education - Pachuri and S C & P Kumar
4. Environmental Education - Dr. Rajeev Saxena
5. Environmental Education - Archana Tomar
6. Environmental Education - Sukla Bhattacharya
7. Jadhav H and Bhosale,V.M. Environmental protection laws. Himalaya publishing house
8.Trivedi R.K.,hand book of environmental laws, rules guidelines, compliances and standards, vol l and ll. Enviro media